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DEPARTMENT OF BIOLOGY, UNIVERSITY OF NOTRE DAME, NOTRE DAME, INDIANA, AND DEPARTMENT OF BIOLOGY, LOYOLA UNIVERSITY, CHICAGO, ILLINOIS.

A Kansas Pleistocene Herpetofauna

J. A. TIHEN

THE following report is based on specimens collected by field parties of the University of Michigan Museum of Vertebrate Paleontology (UMMVP), under the direction of Dr. Claud W. Hibbard, during the summers of 1947, 1951 and 1952, these specimens are now contained in the collection of that institution. They were recovered from a deposit in the Kingsdown Formation (considered a local unit of the Sanborn Formation by Frye and Leonard, 1952) of Meade County, Kansas. The fauna of this deposit has been termed the Jinglebob Fauna by Hibbard (1953). As indicated by van der Schalie (1953), this fauna is tentatively correlated with the Sangamon interglacial. The invertebrates have been discussed by van der Schalie (*op. cit.*), certain mammalian elements of the fauna were described by Rinker (1949), and Oelrich (1953) has described a new species of *Terrapene*.

I wish to express my gratitude to Dr. Hibbard for the opportunity to examine these specimens and prepare this report thereon, and for other assistance he has provided during the course of this study. I also wish to thank Dr. Edward H. Taylor, of the University of Kansas Natural History Museum, for permission to examine comparative skeletal material in the collection of that institution and in his personal collection, and for the many helpful suggestions and other assistance he has offered.

The emphasis in the present study has been on the amphibian fauna. The collections contain a very large number of snake vertebrae and a few dentigerous elements of snakes, but no study was made of these specimens. The turtle remains have been described by Oelrich (*op. cit.*). Specimens of saurian origin will be mentioned briefly, but their identifications must be considered tentative; a more detailed study of the reptilian remains might well be productive.

The specimens were recovered by a method essentially the same as that which yielded the Upper Pliocene amphibian fauna described by Taylor (1942), and, as in that case, all elements recovered are completely dissociated, with the exception of parts of a skeleton of a *Bufo*, to be discussed later. Relative numbers of the various skeletal elements recovered were much the same as listed by Taylor, with a very large number of ilia, a large number of sacral vertebrae, a moderate number of other vertebrae and of certain limb bones, a smaller number of other limb bones and of girdle elements (other than ilia), and a very few cranial elements. Of the cranial elements, actually there are a good many maxillae in the collection, but these are mostly so fragmentary as to be of very little value. I have not counted the exact number of elements found, but there are certainly at least 100 individuals represented in the collection.

AMPHIBIA

CAUDATA

Ambystoma sp.—Salamanders are represented by only a single vertebra. This specimen cannot be distinguished in any way from *Ambystoma* of the present day. No salamanders of any family other than the Ambystomidae have as yet been recovered from Kansas as fossils. Specific identification is impossible on the basis of this meager representation.

SALIENTIA

Scaphiopus (*Spea*) *bombifrons* (Cope).—The spadefoot toads are represented only by one

ilium and one somewhat fragmentary sacral vertebra, with the anterior portion of the fused coccyx. These appear identical with the corresponding elements in Recent *S. bombifrons*. That species is quite distinct from any other member of the genus that I have seen (*holbrooki*, *hammondi*, *hurteri*, and *couchi*) in the extensive webbing between the posterior border of the sacral diapophyses and the shaft of the coccyx. The extent of such webbing, or its absence, appears to be very constant, with only minor variations, within each species, and quite different between species. I believe the fact that *bombifrons* is not subspecifically related to *hammondi* has been clearly established, but it might be added that the skeletal differences between these two forms are of an order of magnitude that would certainly indicate specific difference.

Bufo woodhousei woodhousei Girard.—Toads constitute only a minor part of the present collection, but several individuals are represented. One particular specimen (UMMVP 24398) consists of a number of elements, including the presacral vertebrae, portions of most of the limb bones and girdle elements, and several skull elements, more or less fragmented, but sufficiently complete to allow an accurate reconstruction of the cranial crest pattern. This skeleton, collected by C. C. Carpenter, July 28, 1947, from Lone Tree Arroyo on the XI Ranch, is indistinguishable from large specimens of *Bufo w. woodhousei*, and is probably referable to that subspecies. It is unquestionably more similar to that subspecies than to *B. w. fowleri*.

Several individual elements in the collection are safely referable to this same form. In others there are no diagnostic characters on which to base an identification to the species level, but in none of these is there any indication that a particular element is not referable to this form. Therefore, all specimens of *Bufo* in the collection are tentatively referred to *B. w. woodhousei*.

Acris (?) sp.—Two ilia are definitely referable to the family Hylidae. In general, the fossil ilia appear more similar to those of *Acris* and certain species of *Pseudacris* than to those of *Hyla*, but it is difficult to pick out any specific characteristics, other than size, on which this statement is based. The tentative assignment of these specimens, and one tibiofibula, to *Acris* rather than to *Pseudacris* is based on the probability that individuals of the former are more likely to be preserved because of their habits.

Rana catesbeiana Shaw.—A few portions of ilia and, tentatively, one or two other elements, are referred to this or at least a very closely related form, on the basis of their size, form, and structure of the bone. The bone exhibits the very porous, almost sculptured, consistency typical of this species particularly, and to a lesser extent of related forms such as *R. heckscheri* and *R. grylio*.

Rana pipiens Schreber.—Probably 90 percent of all the amphibian specimens in the collection have been referred to this species. A large number of the individual elements could not, of course, be definitely associated with this form of themselves, but since so many of the identifiable specimens could be so associated, it seemed most reasonable to assume that all specimens of *Rana* not inherently inconsistent with identification as *pipiens* could be assigned to that species with a high percentage of accuracy. There are a very few specimens which have not been referred either to this form or to *catesbeiana*, but these are not uniform among themselves, and cannot be identified closely with any of the other living species I have seen. The presence of other species of frog would not be surprising, but in view of the inability to associate these specimens with any particular Recent form, or with each other, I think it more probable that they simply represent extreme variants of *pipiens*.

In view of the importance which attaches to the sacral vertebra as a criterion for the identification of fossil ranids, it is perhaps pertinent to insert here a few observations on the variation encountered in this element in the Recent forms used as comparative material. These specimens were not examined with the intent of studying variation *per se*, but simply to provide a basis for identification of the fossil specimens. The numbers involved are not sufficient to allow any sort of meaningful statistical analysis, but are strongly indicative of certain variational patterns which can be confirmed or disproven (and measured) by a more detailed and extensive study.

Any differences in proportions that can be recognized subjectively should be as readily, and more accurately, recognizable on the basis

of properly chosen objective measurements. This is certainly true if such objective measurements can be made with sufficient accuracy, but the difficulty of obtaining accurate measurements on objects of such small size and irregular shape is obvious. And a small error in absolute measurements can lead to a rather large error in proportions calculated from such measurements. In many instances, I do not believe errors of rather great magnitude can be avoided without the use of measuring techniques so time-consuming as to be impractical for a work of the present nature. Certain features which appear rather clear-cut and readily recognizable on subjective examination will, from objective measurements taken by ordinary techniques, appear quite variable within a species and show a great deal of overlapping between species. I believe many such features are accurately recognizable subjectively, and that if accurate measurements were to be made, would show the intra-specific variation to be much less, and the inter-specific differences to be much more clear cut, than would be indicated without the use of special measuring techniques. As stated above, careful work of this nature is beyond the scope of the present study, and I have not hesitated in using certain subjective characteristics as aids in identifying the fossil specimens.

One of the more interesting variational trends noted involves the length of the centrum (including condyles) relative to its greatest width, usually at the condyles. Apparently three factors must be taken into account: individual variation within each species, differences between species, and a change within each species correlated with age, or at least with size. Within every form in which specimens of varying sizes were examined, there is a definite increase in the relative length of the centrum in the larger individuals. Therefor, although there may be a great deal of overlap between two different species in respect to this proportion, if the proportion be plotted against some indicator of size, such as the length of the centrum, then separation between the two forms may be shown to be virtually complete.

Rana pipiens was compared with *catesbeiana*, *grylio* and *heckscheri*. No noticeable differences in this feature could be found among the last three species, and the larger number of points obtained by using all three gives, I believe, a more complete picture of the correlation between size and proportions. The indication that the fossil sacrum might be slightly shorter than that of living *pipiens* is probably a reflection of the frequent partial erosion of the articular surfaces, rather than an actual difference (Fig. 1).

A straight line, drawn empirically, separates *pipiens* from the bullfrogs (Fig. 1). This same line may almost equally well separate two large aggregations of American species. There is some indication, though, generally, the number of specimens involved is too small to warrant a definite conclusion, that every species I have examined will fall pretty well above or below this line, with none having a really intermediate range of variation. Thus. *R. clamitans*, *R. palustris*, *R. sylvatica* and *R. virgatipes* appear to have about the same variational pattern as *pipiens*, while *R. capito*, *R. areolata*, and *R. septentrionalis* seem comparable to the *grylio-hecksheri-catesbeiana* group. The significance of such grouping, if it does exist, is not at all clear.

Another feature in which definite interspecific differences are complicated by intraspecific variation correlated with size is the extent of separation of the coccygeal condyles, as compared with the total condylar width (Fig. 2). The condyles are relatively small and widely

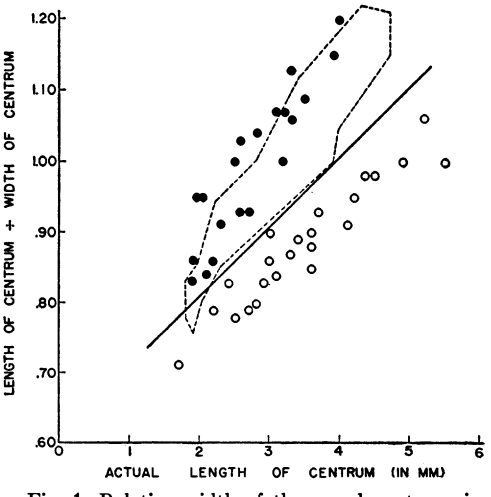

Fig. 1. Relative width of the sacral centrum in *Rana pipiens*, *R. catesbeiana*, *R. grylio* and *R. heckscheri*. Width of the centrum is at the condyles. Dots represent *R. pipiens*; circles, the other three species. Dashed line encloses the total range of variation in the fossil population.

separated in young individuals, becoming larger and heavier, and relatively much closer together, in older ones. In addition, those of *pipiens* are closer together than are those of members of the *catesbeiana* group of comparable size. The extent of variation within a species, and the overlap between species, both appear greater in this character than in the preceding one, but the absolute measurements used in calculating this ratio are smaller, and I believe that errors in measurement are largely responsible for this. There is a close similarity between fossil and Recent *pipiens*.

The angle formed by the posterior borders of the diapophyses, produced until they meet, is also subject to some age variation. In the very young of all forms, this angle is relatively obtuse, becoming more acute as the animal grows larger. Most of the change takes place in the early stages of growth, and there is little or no further change after a certain point has been reached. This angle is rather acute in *pipiens*, as compared with most forms.

Other features that appear to be useful aids in identifying sacral vertebrae include the distance which separates the zygapophyses from each other and the orientation of their articular surfaces, the shape of the ventral surface of the centrum and that of the neural canal. Some species also have special identifying features, which may or may not be shared with other forms, such as the porosity or sculpturing of the bone in *catesbeiana*, shared to a somewhat lesser degree with *grylio* and *heckscheri*, or an extensive longitudinal depression on the ventral surface of the centrum, found occasionally as a variant in several forms, consistently and characteristically in others.

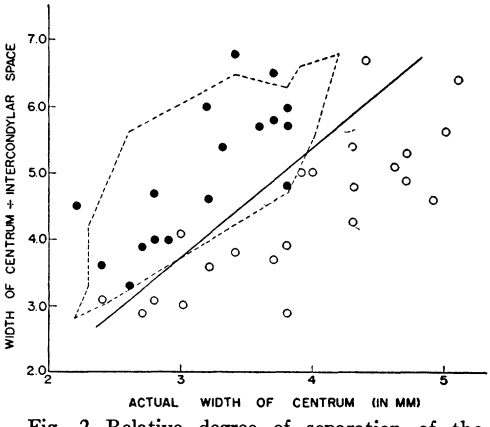

Fig. 2. Relative degree of separation of the sacral condylar stalks from each other in *Rana pipiens*, *R. catesbeiana*, *R. grylio* and *R. heckscheri*. Width of the centrum is the width at the condyles; intercondylar space is the distance between inner edges of the condylar stalks. Dots represent *R. pipiens*; circles, the other three species. Dashed line encloses the total range of variation in the fossil population.

My observations tend to confirm the opinion expressed by Taylor (*op. cit.*) that, considering both the probability of recovery and the number of diagnostic or semi-diagnostic characteristics likely to be exhibited, the sacral vertebra is the most appropriate single element to utilize in the description of fossil forms. However, a number of factors must be taken into consideration in interpreting the characteristics presented by any particular specimen or group of specimens.

REPTILIA

Sauria

Holbrookia (?) sp.—One nearly complete maxilla is tentatively identified as belonging to this genus. It is certainly an iguanid, and differs from most iguanid genera in several respects. It also differs in details from any particular specimen seen of any members of the genera *Holbrookia*, *Uma*, and *Callisaurus*, or of *Sceloporus* and *Uta*, both of which it approaches closely in general form. It appears more closely associated with *Holbrookia* than with *Sceloporus* or *Uta* on the basis of the number of teeth. This specimen probably bore only 17 teeth, while the minimum number observed in any member of the *Sceloporus-Uta* group was 19.

Sceloporus (?) sp.—One pelvis, with the greater part of the ilium and the acetabular portions of the ischium and pubis, is probably safely referable to this genus.

Eumeces sp.—An incomplete dentary can be definitely referred to the genus *Eumeces*, but the specific allocation remains uncertain. In many respects it resembles *E. obsoletus*, a form inhabiting the same area at the present time.

Other reptilian remains.—Several lizard (iguanid) vertebrae are present in the collection. There are many snake vertebrae, a few dentigerous elements of ophidian origin, and a few caudal vertebrae of a turtle. Because of my lack of familiarity with the details of the

osteology of Recent forms in these groups, I am unable to offer even a tentative identification of these specimens.

General Remarks

The most interesting feature of this herpetofauna, so far as it has been identified, is its strong similarity to the living assemblage of this same region. There is not a single specimen in the entire collection which can definitely be referred to some form not now inhabiting this same area. An exception, of course, is *Terrapene llanensis*, described by Oelrich (*op. cit.*). The range of most of these forms is so widespread that their presence here provides little information concerning climatic conditions at the time of deposition of the fossiliferous deposits. In general, they at least do not conflict with the evidence presented by the mammalian and molluscan faunae that the climate at that time was warmer and more humid than at present. One possible exception is the presence, if verified, of *Holbrookia*; the correctness of this identification is so uncertain, however, that little weight can be given it. The absence of any elements definitely referable to such forms as *Phrynosoma* and *Bufo cognatus*, both very common in that region today, might be indicative of less arid conditions, but negative evidence of this sort should be taken into account only with very strong reservations.

Evidence has been accumulating for some time that many of the Recent amphibian genera were already in existence relatively early in the Tertiary. Several extant species have been identified in the Pleistocene, and there is now at least an indication that some Pleistocene forms may not have been distinguishable even subspecifically from their living descendants. Inability to distinguish the Sangamon *Bufo* herein described from the present day *B. w. woodhousei*, on the basis of material available, is no sure indication that subspecific differences did not exist. But Recent *B. w. woodhousei* can be distinguished from other subspecies osteologically, and the fossil form can likewise be distinguished from the other living subspecies of *woodhousei*. So it can safely be stated at least that, as far as skeletal characteristics are concerned, this Sangamon form is more similar to the subspecies now living in the same area than are the existing subspecies to each other.

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Harper, Kansas.

Herpetological Notes

A RANGE EXTENSION OF THE SALAMANDER *GYRINOPHILUS PORPHYRITICUS PORPHYRITICUS*.—An adult of *Gyrinophilus p. porphyriticus* (Green) was collected by the writer on April 2, 1953, in Blount County, Alabama. The locality was approximately 3 miles north of Warrior, and one-half mile north of the road running east to Hayden, in a deep ravine lying east of and parallel to U.S. Highway 31. The animal was 150 mm. in total length, 18.5 from snout to gular fold, and 67.5 from snout to vent. There were eleven white spots on the venter indicating possible parasitization.

A steep rocky tributary to the valley stream passes under the highway through a large rock-and-cement culvert, and a spring-alcove environment is simulated where it emerges. The situation is permanently shaded, cool, and mossy. The *Gyrinophilus*